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STRUCTURES AND VARIATIONS OF THE ATMOSPHERE ON VENUS

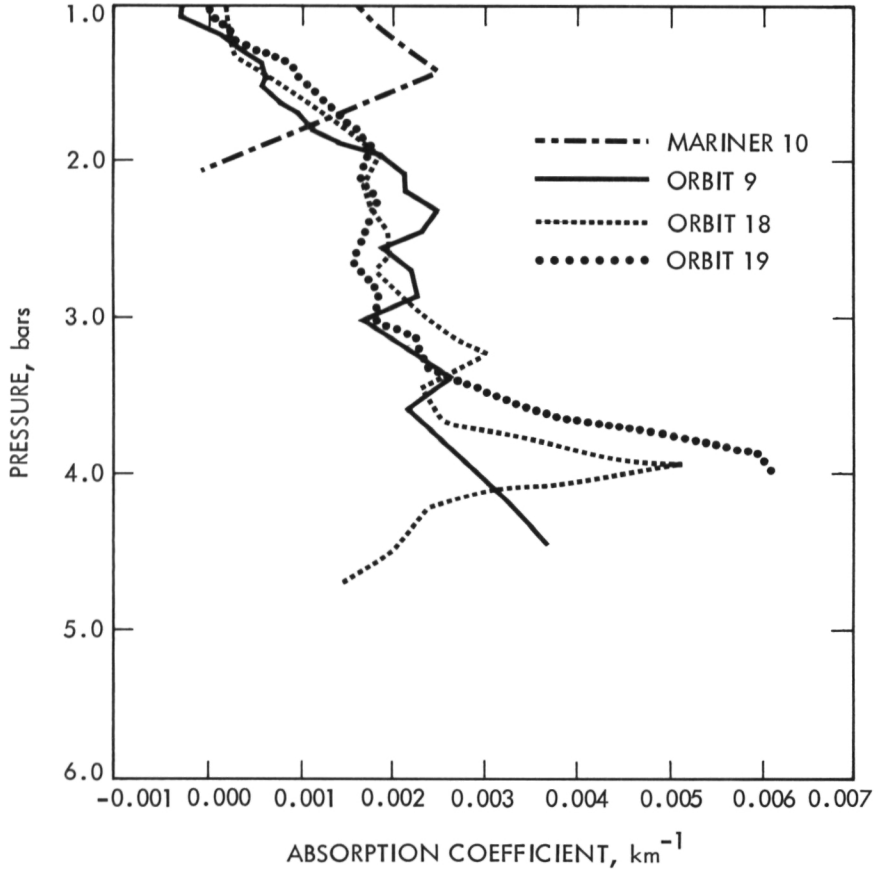
The radio occultation experiment aboard the Pioneer Venus Orbiter has been used to study latitudinal variations in the vertical structure of the Venus atmosphere and cloud morphology in the polar regions of Venus. As the spacecraft, which has circled Venus every 24 hours since December 1978, passes behind the planet in relation to the Earth, its radio signals (13.06 and 3.56 centimeters) are occulted.

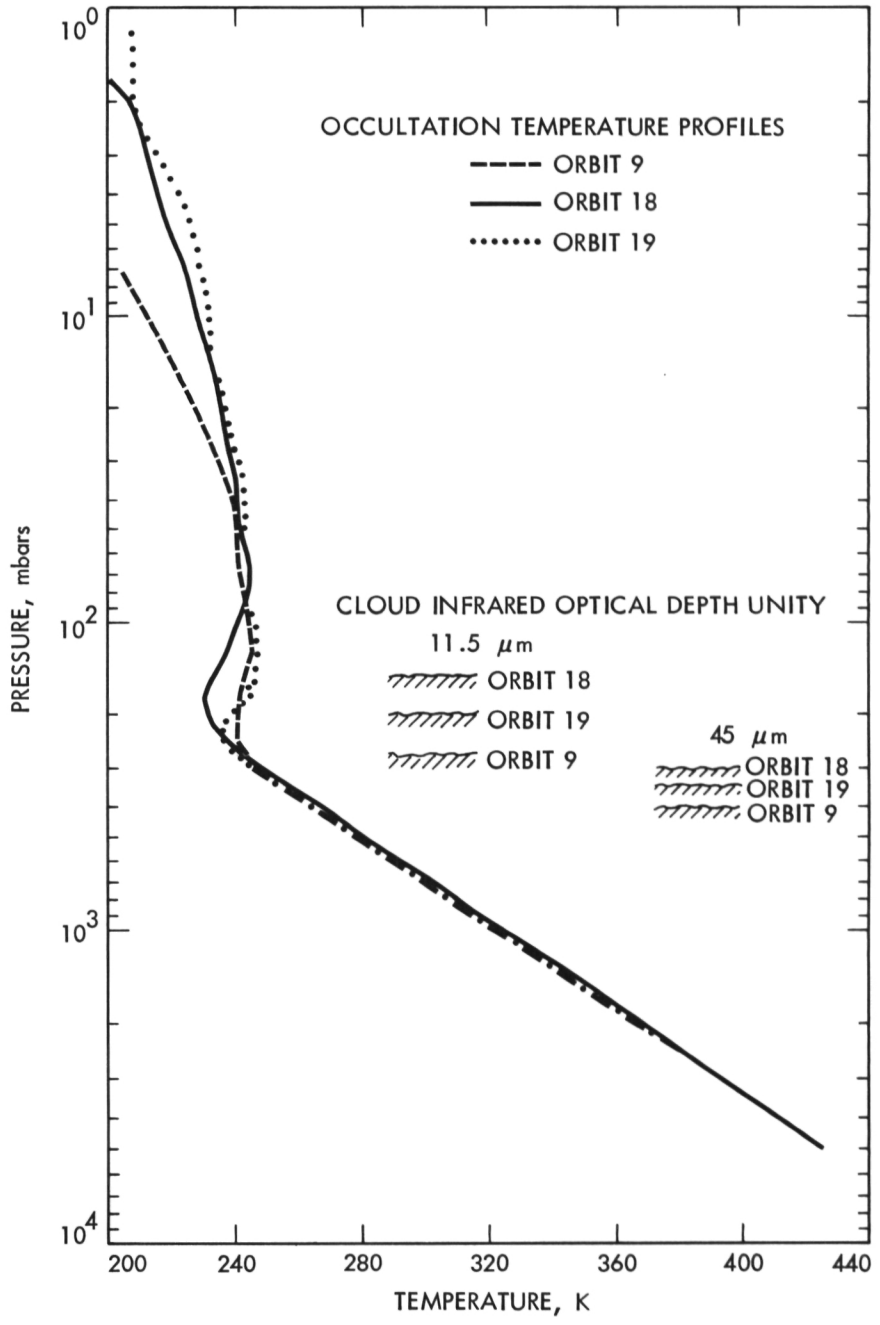
Many radio occultation data sets, taken at different latitudes, have provided information on changes in the temperature structure with latitude. Thirteen measurements taken at north and south latitudes ranging from 7.1 to 88.3 degrees have revealed the existence of a temperature inversion at the level of the tropopause. The tropopause is a region of transition between the troposphere, in which convection dominates, and the stratosphere, in which radiative processes dominate. Comparisons with the observations of the Venus Orbiter infrared radiometer indicate that this tropopause region corresponds to the level of the tops of the visible clouds. The deepest inversions occur at latitudes between 60 and 70 deg, where a cold collar cloud feature was observed by the radiometer. The inversion disappears at latitudes lower than about 45 deg, and its magnitude decreases poleward of 70 deg, indicating a lowering of the tropopause region from a level of about 86 millibars at 70 deg to about 200 mbars at 87 deg.

The temperature structure of the middle and lower atmosphere was found to be remarkably similar for measurements taken at the same latitude, but independent of the hemisphere, the time between measurements, or the solar illumination conditions. This indicates a symmetrical and very stable circulation pattern in the atmosphere of Venus.

S-band data from Pioneer orbits 9, 18, and 19 were used to study the vertical cloud structure in the north polar region. These occultation profiles represent three different regions of the north pole in terms of vertical temperature structure and proximity to the polar hot spots (regions of elevated temperatures) as seen by the 11.5-micrometer infrared radiometer aboard Pioneer. Dense cloud decks were revealed at the 1- to 5-bar level of the atmosphere. The cloud decks are lower in altitude and denser than those found in the equatorial region by the Mariner 10 radio occultation experiment and the Pioneer probes. These lower clouds appear to be fairly uniform in absorption properties throughout the polar region, with some suggestion of a deeper peak absorption near the polar hot spots.

Data from the 11.5-μm channel of the JPL infrared radiometer aboard Pioneer Orbiter were combined with the occultation temperature data to interpret the upper cloud structure in the north polar region. Regions near the hot spots appear to have depressed upper cloud heights as well as increased optical density. These areas lack the temperature inversions characteristic of the north polar regions far from the hot spots. In addition, the cloud tops at the pole are about 100 mbars deeper in the atmosphere than at the equator.





The Pioneer Venus spacecraft has been orbiting Venus every 24 hours since December 4, 1978. As the spacecraft passes behind the planet, the radio signals (13.06 and 3.56 centimeters) are occulted twice: at entry into and at exit from occultation. Each occultation provides data for the analysis of the structure of the Venus atmosphere in terms of temperature, pressure, and absorption coefficient. These profiles are used to study the vertical cloud structure in the Venus atmosphere.